Remarks

The following remarks are provided in further support of the Claims.

Objections

Claims 3 and 17 are objected to because of the following informalities: Correct "parallelpipeds" to read as "parallelepipeds". Claims 3 and 17 have been amended to correct the informalities.

Rejections

Rejection Under 35 U.S.C. §112

Claims 5, 11, and 18 are rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 5 is vague and indefinite because of the use of the word "approximately".

Claim 11 recites the limitation "the pressing process" for which there is insufficient antecedent basis.

Claim 18 is vague and indefinite because of the use of the word "approximately".

Rejection Under 35 U.S.C. §103(a)

Claims 1-7 and 9-18 are rejected under 35 U.S.C. §103(a) as being unpatentable over Carr et al. (PCS ELITE – A Complete Die Compaction Software Package") in view of Applicants' Own Admission (specification page 4, lines 3-4, page 5, line 17.

Claim 8 is rejected under 35 U.S.C. §103(a) as being unpatentable over Carr et al. (PCS ELITE – A Complete Die Compaction Software Package") in view of Applicants' Own Admission (specification page 4, lines 3-4, page 5, line 17, and further in view of Zipse, 1997.

I. DISCUSSION (Objection)

Claims 3 and 17 have been amended to provide the proper spelling.

II. DISCUSSION (Rejection Under 35 USC 112

Claims 5 and 11 have been amended to eliminate the word "approximately". Claim 11 has been canceled.

III. DISCUSSION (Rejection Under 35 USC 103(e). Carr et al. in view of Applicant's own admission, Specification, page 4, lines 3-4 and page 5, line 17.

Carr et al. describes the traditional process of setting up a die compaction simulation, whereby, 1) a drawing tool (e.g., CAD software) is used to draw the cross section of the forming die and powder/compact (i.e., the size and shape of the powder in the die before pressing) to scale from scratch. Generic CAD drawings cannot typically be easily imported into a finite element simulation tool without extensive adaptations, as described by Carr et al. Drawing the die to scale from scratch is a time consuming and labor intensive step that can take hours.
2) Software is used to construct the FE mesh for the compaction simulation. Traditionally, meshing requires specialized expertise to determine the coarseness of the FE mesh (i.e., to minimize the simulation time required to complete an accurate simulation), and to know where to and how to add finer mesh features at critical regions (e.g., where there is a sharp radius or transition radius). Meshing can be a tedious and time-consuming (e.g., hours) process for an expert. Improper meshing (e.g., by a non expert) will lead to simulations that cannot run to completion, or to nonsensical, inaccurate, or incorrect results.

3) The boundary conditions for the compaction simulation are defined in the FE mesh, including what nodes move (i.e., the pressing punches), what nodes are fixed (e.g., the non-moving die walls), the friction between the powder/compact and the forming die on different surfaces, and what the finished (pressed) conditions are (e.g., the size and shape of the powder compact after pressing). Defining the boundary conditions can be tedious and time consuming (e.g., hours).
4) The properties of the powder/compact and of the forming die and the forming punches are defined in the FE mesh. The traditional Carr et al. approach requires entering different property values for the different materials. Additionally, the mesh must be defined such that different properties can be assigned to specific geometric areas of the FE mesh to complete the simulation. At a minimum, this step can take minutes.

To complete the entire setup process typically requires an expert in FE analysis, and requires a significant amount of work and time, especially for a complex part. Furthermore, significant changes can require restarting the process from scratch.

Carr et al., page 10-114, teaches a method of drawing to scale in the CAD component the geometry of interest. The procedure uses vertices, lines and arcs or can use the "primitive builder" to construct geometric representations of the powder and tooling. Carr et al. note that the software won't import CAD files from other programs and that the actual tooling drawings require simplification in finite element analysis. In the method of the present invention, as stated by the amended claim 1, predefined geometric shapes are available to construct the primary geometry. A user responds to on-screen line queries to input all of the required part dimensions to quickly and easily construct the cross section of the forming die and the size/shape of the powder fill for the finite element (FE) compaction simulation. All of the required geometric features (i.e., the basic starting geometric features and the features that join them to produce the die/compact geometries) are already embedded in the program, so the part can be constructed quickly from a simple hand drawing. No expertise with CAD software is required, and the part is automatically

drawn to scale from the query-driven user input. All of the required geometric features are already in the software, so it is impossible to "miss" a critical feature in the design. The part geometric "drawing" step in the subject invention is typically easily completed in 15 minutes or less.

As noted by Carr et al., page 10-116, the tooling material model requires property values for the material density, elastic modulus, and Poisson's ratio, which "are usually available in handbooks." In the method of the present invention, as noted on page 10, line 26, the user can simply input the material type selected from standard materials used in the industry and the method supplies these property values automatically without further user input.

As noted by Carr et al., page 10-117, the program described therein supports two different means of creating a finite element mesh, both requires significant user input (as noted in Applicant's 1.132 Declaration, attached), sometimes resulting in meshes of poor quality. In the method of the present invention, as specified in amended claim 1, the predefined geometric shapes are automatically meshed through internal computer software into a finite element mesh with little user input. As also noted in Applicant's 1.132 Declaration, the method of the present invention does not require the simulation user to have expertise in finite element modeling and significantly reduces the time to prepare the simulation. The user responds to on-screen line queries to quickly and easily construct the mesh for the FE simulation. All of the features that are needed to successfully run a compaction simulation are already in the software (e.g., including the requirement of generating finer meshes around sharp radius features), so it is impossible to "miss" anything critical. Furthermore, the simple guidelines provided help the user define the appropriate coarseness of the mesh to complete an accurate simulation quickly. As such, no extensive expertise with meshing and/or meshing software is required. A non-expert can easily construct the mesh for a FE compaction simulation in minutes. Furthermore, the user can quickly and easily review the mesh, and even easily and quickly modify the mesh prior to complete a compaction simulation or a series of simulations (e.g., to quickly optimize a design).

As noted by the Applicants 1.132 Declaration, by using the modular approach of the present invention and eliminating the need to make many of the decisions necessary to set up a compaction simulation from scratch, the subject invention can be used by a non-expert in a manufacturing environment to complete accurate die compaction simulations quickly and easily (i.e., in minutes versus hours or days relative to the traditional approach described in prior art).

Therefore, Carr et al. in view of Applicants' own admissions as noted neither teach or suggest a method of generating a primary geometry using predefined geometric shapes and transition radii where the geometry has a finite element mesh automatically prepared through interfaced software, with material properties and boundary conditions defined through a user interface and subsequent calculation and evaluation of the deformation characteristics of the geometry , as described in claims 1-7, 10, 12-13, and 15-18.

IV. DISCUSSION (Rejection Under 35 USC 103(e), Carr et al. in view of Applicant's own admission, Specification, page 4, lines 3-4 and page 5, line 17, and further in view of Zipse, 1997.

Zipse, 1997, describe a three-dimensional geometry. However, as discussed in Section III, Carr et al. in view of Applicant's own admission neither teach or suggest a method of generating a primary geometry using predefined geometric shapes and transition radii where the geometry has a finite element mesh automatically prepared through interfaced software, with material properties and boundary conditions defined through a user interface and subsequent calculation and evaluation of the deformation characteristics of the geometry , as described in claim 1. Therefore, claim 8, being dependent on claim 1, is not taught or suggested by Carr et al. in view of Applicant's own admission and further in view of Zipse.

CONCLUSION

Applicants have responded to each and every rejection raised by the Office and, in concurrence with the Office, consider that claims 1-8, 10, 12-13 and 15-18 are now in condition for allowance. Applicants request expeditious processing to issuance.

Respectfully submitted,

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